

T01D06 – Quantitative Practice

Name.....

1. A toxic gas, A, consists of 53.8% nitrogen and 46.2% carbon by mass. At 273 K and 1.01×10^5 Pa, 1.048 g of A occupies 462 cm^3 . Determine the empirical formula of A. Calculate the molar mass of the compound and determine its molecular structure.

(Total 3 marks)

2. (i) Calcium carbonate is added to separate solutions of hydrochloric acid and ethanoic acid of the same concentration. State **one** similarity and **one** difference in the observations you could make.

(2)

- (ii) Write an equation for the reaction between hydrochloric acid and calcium carbonate.

(2)

- (iii) Determine the volume of 1.50 mol dm^{-3} hydrochloric acid that would react with exactly 1.25 g of calcium carbonate.

(3)

- (iv) Calculate the volume of carbon dioxide, measured at 273 K and 1.01×10^5 Pa, which would be produced when 1.25 g of calcium carbonate reacts completely with the hydrochloric acid.

(2)**(Total 9 marks)**

3. An organic compound A contains 62.0% by mass of carbon, 24.1% by mass of nitrogen, the remainder being hydrogen.

- (i) Determine the percentage by mass of hydrogen and the empirical formula of A.

(3)

- (ii) Define the term *relative molecular mass*.

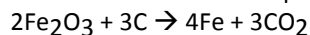
(2)

- (iii) The relative molecular mass of **A** is 116. Determine the molecular formula of **A**.

(1)

(Total 6 marks)

4. The reaction below represents the reduction of iron ore to produce iron.



A mixture of 30 kg of Fe_2O_3 and 5.0 kg of C was heated until no further reaction occurred.

Calculate the maximum mass of iron that can be obtained from these masses of reactants.

(Total 5 marks)

5. 0.502 g of an alkali metal sulfate is dissolved in water and excess barium chloride solution, $\text{BaCl}_2(\text{aq})$ is added to precipitate all the sulfate ions as barium sulfate, $\text{BaSO}_4(\text{s})$. The precipitate is filtered and dried and weighs 0.672 g.

(a) Calculate the amount (in mol) of barium sulfate formed.

(2)

(b) Determine the amount (in mol) of the alkali metal sulfate present.

(1)

(c) Determine the molar mass of the alkali metal sulfate and state its units.

(2)

(d) Deduce the identity of the alkali metal, showing your workings.

(2)

(e) Write an equation for the precipitation reaction, including state symbols.

(2)

(Total 9 marks)

6. (i) Crocetin consists of the elements carbon, hydrogen and oxygen. Determine the empirical formula of crocetin, if 1.00 g of crocetin forms 2.68 g of carbon dioxide and 0.657 g of water when it undergoes complete combustion.

(6)

- (ii) Determine the molecular formula of crocetin given that 0.300 mole of crocetin has a mass of 98.5 g

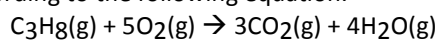
(2)

(Total 8 marks)

7. State and explain what would happen to the pressure of a given mass of gas when its absolute temperature and volume are both doubled.

(Total 3 marks)

8. Propane and oxygen react according to the following equation.



Calculate the volume of carbon dioxide and water vapour produced and the volume of oxygen remaining, when 20.0 dm³ of propane reacts with 120.0 dm³ of oxygen. All gas volumes are measured at the same temperature and pressure.

(Total 3 marks)

Multiple Choice Practice:

1. 3.0 dm^3 of sulfur dioxide is reacted with 2.0 dm^3 of oxygen according to the equation below.
- $$2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{SO}_3(\text{g})$$

What volume of sulfur trioxide (in dm^3) is formed? (Assume the reaction goes to completion and all gases are measured at the same temperature and pressure.)

- A. 5.0
B. 4.0
C. 3.0
D. 2.0
2. The equation for a reaction occurring in the synthesis of methanol is
- $$\text{CO}_2 + 3\text{H}_2 \rightarrow \text{CH}_3\text{OH} + \text{H}_2\text{O}$$
- What is the maximum amount of methanol that can be formed from 2 mol of carbon dioxide and 3 mol of hydrogen?
- A. 1 mol
B. 2 mol
C. 3 mol
D. 5 mol
3. What will happen to the volume of a fixed mass of gas when its pressure and temperature (in Kelvin) are both doubled?
- A. It will not change.
B. It will increase.
C. It will decrease.
D. The change cannot be predicted.
4. The temperature in Kelvin of 2.0 dm^3 of an ideal gas is doubled and its pressure is increased by a factor of four. What is the final volume of the gas?
- A. 1.0 dm^3
B. 2.0 dm^3
C. 3.0 dm^3
D. 4.0 dm^3
5. Under what conditions would one mole of methane gas, CH_4 , occupy the smallest volume?
- A. 273 K and $1.01 \times 10^5 \text{ Pa}$
B. 273 K and $2.02 \times 10^5 \text{ Pa}$
C. 546 K and $1.01 \times 10^5 \text{ Pa}$
D. 546 K and $2.02 \times 10^5 \text{ Pa}$
6. Which change in conditions would increase the volume of a fixed mass of gas?

	Pressure /kPa	Temperature /K
A.	Doubled	Doubled
B.	Halved	Halved
C.	Doubled	Halved
D.	Halved	Doubled

7. For which set of conditions does a fixed mass of an ideal gas have the greatest volume?

	Temperature	Pressure
A.	low	low
B.	low	high
C.	high	high
D.	high	low